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The costs of hard coal production in Poland

ABSTRACT. The paper is the result of the project “Evaluation of State aid for the coal industry” which was performed by Europe Economics, Fraunhofer ISI with BSR Sustainability and Krakow Institute for Sustainable Energy in cooperation with MEERI (Evaluation of State aid..., 2006). The report included case studies performed in four European countries (the Czech Republic, Germany, Spain and Poland). This article is a part of case study performed for Polish coal industry. The aim of the survey was to analyse the trends in domestic hard coal production cost. The costs of individual mines as well as their trends for the whole coal sector were analyzed.

The paper presents two different approaches to hard coal production costs analysis in Polish coal mines. In the first part the comparison of hard coal production costs (and cost components) was carried out. The second part of the survey examines coal production costs for the whole coal mining sector.

KEY WORDS: hard coal, costs of production

1. The costs of hard coal production for individual mines

Issues related to the costs of coal production are broadly discussed in Polish literature (Gawlik 2006; Gawlik 2004; Czopek 2003). Presented research aims to focus on one of the aspects of coal companies operation, namely trends and structure of coal costs production. For

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the purpose of this survey two types of mines were distinguished – coking coal mines (mines that produced more than 50% of coking coal) and steam coal mines (mines that produced more than 50% of steam coal). Additionally, the structure of costs in relation to wages, depreciation, consumption of materials, consumption of energy and other costs are shown. The presented figures and data do not include inputs from a few mines, for which it was impossible to obtain the data: namely Bogdanka S.A., Budryk S.A., ZGE Jaworzno–Sobieski III S.A. and the only private mine in Poland – Siltech Sp. z o.o. The annual production of these companies is approximately 11 mln tons, what gives about 100 mln tons in Poland (2003). The total production of the companies presented in the survey amounts to 89 mln tons.

The analysis of the data shows that the average cost of hard coal production is 142.78 PLN/ton. The cost of production in steam coal mines is lower (135.67 PLN/ton) while in coking coal mines it is much higher than the average (174.37 PLN/ton) (Table 1).

TABLE 1. The unit costs of hard coal production in Poland, 2003 [PLN/ton]

TABELA 1. Koszty jednostkowe produkcji węgla kamiennego w Polsce, 2003 [PLN/ton]

Nr of mine	Production	Unit cost	Wages	Materials	Depreciation	Energy	Other costs
1	2 940 472	134.16	70.62	16.23	6.86	4.72	35.73
2	1 537 043	139.20	69.80	20.44	6.46	7.57	34.93
3	1 140 054	157.06	76.17	19.19	9.14	6.27	46.29
4	1 327 432	168.97	92.05	13.94	13.58	7.97	41.43
5	2 549 199	151.11	83.16	18.52	11.50	9.03	28.90
6	2 540 177	139.87	80.94	14.67	8.41	7.07	28.78
7	1 790 600	146.74	75.46	18.99	11.66	5.83	34.80
8	1 603 250	160.79	84.19	19.63	11.90	6.09	38.98
9	1 402 364	141.38	74.29	15.40	11.52	7.15	33.02
10	2 874 679	128.70	70.38	13.20	11.69	5.94	27.49
11	2 718 268	131.58	67.28	13.57	10.72	5.78	34.23
12	2 382 194	139.55	71.48	16.11	12.83	6.98	32.15
13	2 377 692	140.70	77.11	10.04	12.16	7.51	33.88
14	1 381 958	137.55	78.89	10.24	6.70	8.59	33.13
15	2 962 368	114.49	63.29	10.31	7.45	8.12	25.32
16	1 497 474	198.30	112.95	22.67	12.22	10.37	40.09
17	3 704 104	125.06	64.24	9.82	11.84	9.21	29.95
18	2 169 717	150.13	71.08	20.71	8.07	9.18	41.09
19	2 396 010	153.22	84.32	16.90	12.81	5.11	34.08
20	3 890 255	124.76	65.87	16.54	5.42	7.79	29.14
21	1 591 443	191.67	96.01	23.36	20.08	12.21	40.01
22	1 016 346	171.72	111.60	18.05	5.06	10.75	26.26
23	2 025 121	127.26	79.87	9.36	8.70	6.93	22.40
24	1 826 246	128.48	71.88	11.59	12.36	7.24	25.41
25	5 653 291	111.53	68.69	9.82	7.15	4.08	21.79
26	1 102 086	120.94	62.40	8.90	10.02	7.61	32.01
27	4 112 810	105.88	63.00	9.89	5.60	4.62	22.77
28	2 223 799	132.66	76.11	8.35	11.71	6.74	29.75
29	1 628 297	156.25	89.22	14.99	14.12	3.87	34.05
30	2 200 611	145.49	80.80	11.11	10.65	7.89	35.04
31	2 330 107	116.69	74.20	9.36	6.13	1.63	25.37
32	2 909 018	136.46	76.67	12.36	8.23	5.63	33.57
33	2 619 682	199.06	81.41	24.33	12.92	14.96	65.44
34	3 122 352	169.97	90.82	19.85	15.55	9.55	34.20
35	2 381 425	149.20	63.54	20.26	11.51	12.49	41.40
36	3 757 087	167.92	85.33	19.90	10.71	13.05	38.93
37	2 848 964	196.37	89.72	21.37	16.35	12.35	56.58
Steam coal mines	72 176 188	135.62	74.67	13.79	9.56	6.79	30.81
Coking coal mines	16 357 807	174.37	83.73	20.42	13.43	11.57	45.22
Total	88 533 995	142.78	76.34	15.02	10.27	7.68	33.47

Source: own calculations based on coal companies data

The dominant component in the cost structure (Table 2) are wages with the average share of 53.47%. It is noticeable that the share of wages is less significant in the coking coal mines (48.02%) than in steam coal mines (55.06%). This fact is due to higher costs of production in coking coal mines, because the wages are of similar magnitude, leading to the 7% difference. The next important cost category is “other costs” (services, environmental charges etc.) Its share was approximately 23.44% of the total, with not significant differences among the particular coal mines. The remaining cost categories, namely consumption of materials, depreciation and consumption of energy, accounted for 10.52%, 7.19% and 5.38%, respectively.

TABLE 2. The costs structure of hard coal production in Poland, 2003 [%]

TABELA 2. Struktura kosztów produkcji węgla kamiennego w Polsce, 2003 [%]

Nr of mine	Unit cost	Wages	Materials	Depreciation	Energy	Other costs
1	100.00	52.64	12.10	5.11	3.52	26.63
2	100.00	50.14	14.68	4.64	5.44	25.09
3	100.00	48.50	12.22	5.82	3.99	29.47
4	100.00	54.48	8.25	8.04	4.72	24.52
5	100.00	55.03	12.26	7.61	5.98	19.13
6	100.00	57.87	10.49	6.01	5.05	20.58
7	100.00	51.42	12.94	7.95	3.97	23.72
8	100.00	52.36	12.21	7.40	3.79	24.24
9	100.00	52.55	10.89	8.15	5.06	23.36
10	100.00	54.69	10.26	9.08	4.62	21.36
11	100.00	51.13	10.31	8.15	4.39	26.01
12	100.00	51.22	11.54	9.19	5.00	23.04
13	100.00	54.80	7.14	8.64	5.34	24.08
14	100.00	57.35	7.44	4.87	6.25	24.09
15	100.00	55.28	9.01	6.51	7.09	22.12
16	100.00	56.96	11.43	6.16	5.23	20.22
17	100.00	51.37	7.85	9.47	7.36	23.95
18	100.00	47.35	13.79	5.38	6.11	27.37
19	100.00	55.03	11.03	8.36	3.34	22.24
20	100.00	52.80	13.26	4.34	6.24	23.36
21	100.00	50.09	12.19	10.48	6.37	20.87
22	100.00	64.99	10.51	2.95	6.26	15.29
23	100.00	62.76	7.36	6.84	5.45	17.60
24	100.00	55.95	9.02	9.62	5.64	19.78
25	100.00	61.59	8.80	6.41	3.66	19.54
26	100.00	51.60	7.36	8.29	6.29	26.47
27	100.00	59.50	9.34	5.29	4.36	21.51
28	100.00	57.37	6.29	8.83	5.08	22.43
29	100.00	57.10	9.59	9.04	2.48	21.79
30	100.00	55.54	7.64	7.32	5.42	24.08
31	100.00	63.59	8.02	5.25	1.40	21.74
32	100.00	56.18	9.06	6.03	4.13	24.60
33	100.00	40.90	12.22	6.49	7.52	32.87
34	100.00	53.43	11.68	9.15	5.62	20.12
35	100.00	42.59	13.58	7.71	8.37	27.75
36	100.00	50.82	11.85	6.38	7.77	23.18
37	100.00	45.69	10.88	8.33	6.29	28.81
Steam coal mines	100.00	55.06	10.17	7.05	5.01	22.72
Coking coal mines	100.00	48.02	11.71	7.70	6.64	25.93
Total	100.00	53.47	10.52	7.19	5.38	23.44

Note: mines producing coking coal – grey colour

Source: own calculations based on coal companies data

The differences in unit costs for individual mines are illustrated in the Fig. 1. The reasons for such a variation are related to several factors, among which geological conditions and productivity are the most important. As it was impossible to investigate all the mines in

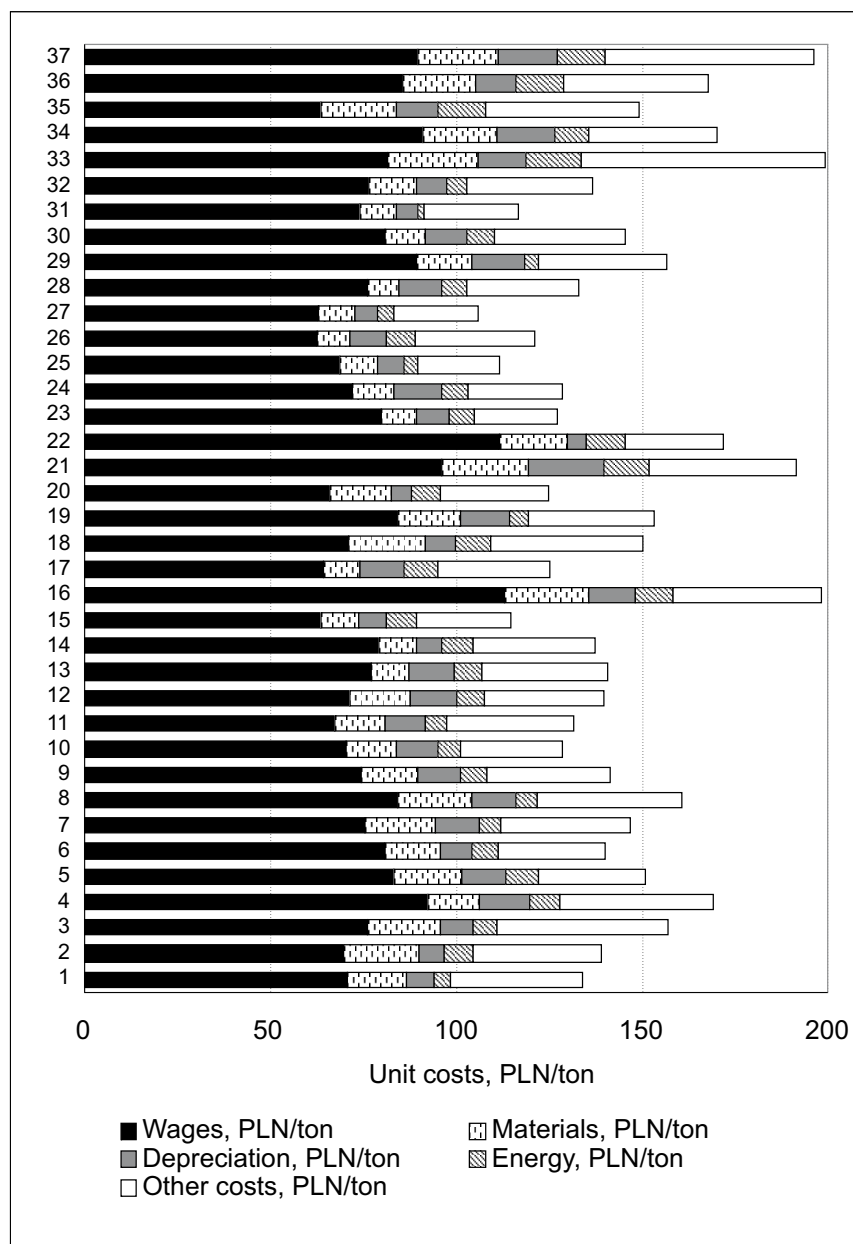


Fig. 1. The unit costs of hard coal production in Poland, 2003 [PLN/ton]
Source: own calculations based on coal companies data

Rys. 1. Koszty jednostkowe produkcji węgla kamiennego w Polsce, 2003 [PLN/ton]

detail, it was difficult to distinguish to what extent the differences in costs are related to objective factors or subjective ones such, as management quality. The improvement of management quality may lead to increased efficiency and to costs reductions in consequence.

Based on the production and cost data the coal cost curves were obtained (Fig 2 – all coal mines; Fig. 3 – steam coal mines). The coal cost curve for all coal mines is practically linear up to 80 mln tons, and for steam coal mines up to 60 mln tons. Above those values a sharp increase of slope is noticeable, particularly in case of steam coal, which means that at least the criterion for closures based on cost curves is rather well defined. Of course, other criteria, like social costs or coal reserves have to be taken into account too (coal mines with exceptionally high costs are those listed as 3, 22, 21 and 16).

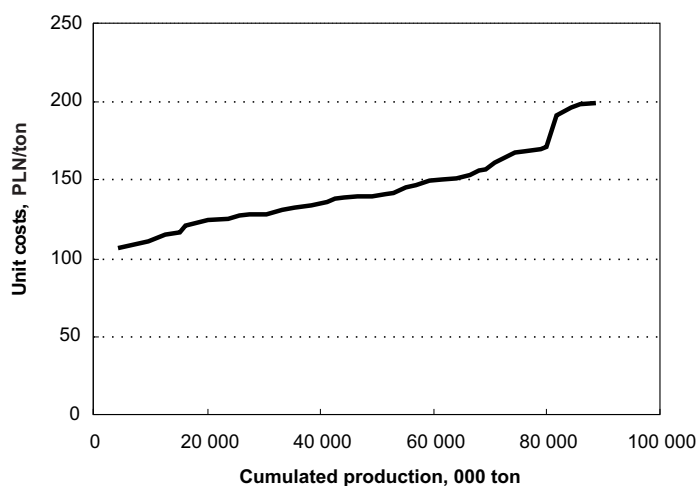


Fig. 2. Hard coal production cost curve, 2003
Source: own calculations based on coal companies data

Rys. 2. Krzywa kosztów produkcji węgla kamiennego, 2003

In a typical competitive market, with homogeneous product and properly functioning market mechanisms, such a curve is regarded as a supply curve. Therefore, depending on the market demand, the price of market equilibrium is determined. The coal mines which have production costs below the equilibrium price gain extraordinary profits – the difference between the price and the unit costs. However, in the Polish coal market such an interpretation is not valid, because of its specific features (inhomogeneous product, state ownership, monopolistic practices of coal companies, rigid tariffs for coal etc.). This leads to the conclusion that such cost curves reflect the relationships in the coal market only approximately. It is almost inevitable that diminished demand will lead to reduction in coal production, and possibly to closure of coal mines. However, it is hard to say which of hard coal mines should be closed based on the cost curve analysis, as the decision on closure of the mine is not always based on the economic considerations. Equally important factors are: quality of coal, coal price, reserves, geological conditions and very often political issues.

TABLE 3. Cumulated production of hard coal, 2003

TABELA 3. Skumulowana produkcja węgla kamiennego, 2003

Nr of mine	Production, ton	Unit cost, PLN/ton	Cumulated production, 000 ton
27	4 113	105.88	4 113
25	5 653	111.53	9 766
15	2 962	114.49	12 728
31	2 330	116.69	15 059
26	1 102	120.94	16 161
20	3 890	124.76	20 051
17	3 704	125.06	23 755
23	2 025	127.26	25 780
24	1 826	128.48	27 606
10	2 875	128.70	30 481
11	2 718	131.58	33 199
28	2 224	132.66	35 423
1	2 940	134.16	38 364
32	2 909	136.46	41 273
14	1 382	137.55	42 655
2	1 537	139.20	44 192
12	2 382	139.55	46 574
6	2 540	139.87	49 114
13	2 378	140.70	51 492
9	1 402	141.38	52 894
30	2 201	145.49	55 095
7	1 791	146.74	56 885
35	2 381	149.20	59 267
18	2 170	150.13	61 436
5	2 549	151.11	63 986
19	2 396	153.22	66 382
29	1 628	156.25	68 010
3	1 140	157.06	69 150
8	1 603	160.79	70 753
36	3 757	167.92	74 510
4	1 327	168.97	75 838
34	3 122	169.97	78 960
22	1 016	171.72	79 976
21	1 591	191.67	81 568
37	2 849	196.37	84 417
16	1 497	198.30	85 914
33	2 620	199.06	88 534

Source: own calculations based on coal companies data

Important components that should be included in the construction of coal curves are financial costs and the additional operational costs. These costs, although they are not directly included in production activity cost, also influence the final price. However, individual coal mines that enter a given holding or company being only production units, do not keep separate full accounting. Therefore, all the costs indirectly linked with production are included only at the coal company or holding level (Kompania Węglowa SA, Katowicki Holding Węglowy SA, Jastrzębska Spółka Węglowa SA). This is the main reason for which financial costs were not included in the calculation of the costs of production for individual production units (mines). The inclusion of financial costs would move the cost curves upwards.

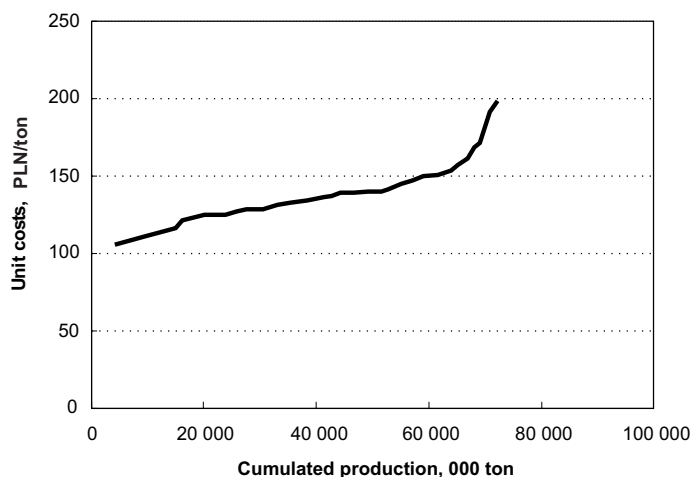


Fig. 3. Hard coal production cost curve (steam coal mines), 2003
Source: own calculations based on coal companies data

Rys. 3. Krzywa kosztów produkcji węgla kamiennego (kopalnie produkujące głównie węgiel energetyczny), 2003

2. The costs of hard coal production – the whole coal sector (1991–2004)

The costs presented in previous chapter give a general overview of the differences among coal mines in Poland. However, to assess the effects of transformation of the coal sector it is necessary to analyse the cost data for a longer time interval. Therefore, in this chapter the average costs of coal production are analysed for coal companies as well as for the whole coal mining sector based on the quarterly data (1991–2004). The costs in constant prices were calculated for the 4th quarter of 2004 (consumer goods and services price index was used).

The unit costs of hard coal production are presented in Table 5 (current prices) and Table 6 (constant prices). Based on the data presented in these tables the structure of production costs was calculated (Table 7).

With the restructuring of the industry and the change of its structure (shift from heavy industry to lighter industries and services) and decrease of energy intensity of the GDP, which occurred due to transformation of Polish economy, the coal sector was forced to reduce its production. The annual coal production decreased from 137.5 mln tons in 1991 to approximately 100 mln tons in 2004 (i.e. by 27%). The downward trend has been constant since 1991. However, it is noticeable that the production of coal has stabilised at the level of 25 mln tons quarterly since 2000. The quarterly production fluctuations are caused by seasonal demand differences.

TABLE 4. Cumulated production of hard coal (steam coal mines), 2003

TABELA 4. Skumulowana produkcja węgla kamiennego (kopalnie produkujące głównie węgiel energetyczny), 2003

Nr of mine	Production, ton	Unit cost, PLN/ton	Cumulated production, 000 ton
27	4 113	105.88	4 113
25	5 653	111.53	9 766
15	2 962	114.49	12 728
31	2 330	116.69	15 059
26	1 102	120.94	16 161
20	3 890	124.76	20 051
17	3 704	125.06	23 755
23	2 025	127.26	25 780
24	1 826	128.48	27 606
10	2 875	128.70	30 481
11	2 718	131.58	33 199
28	2 224	132.66	35 423
1	2 940	134.16	38 364
32	2 909	136.46	41 273
14	1 382	137.55	42 655
2	1 537	139.20	44 192
12	2 382	139.55	46 574
6	2 540	139.87	49 114
13	2 378	140.70	51 492
9	1 402	141.38	52 894
30	2 201	145.49	55 095
7	1 791	146.74	56 885
18	2 170	150.13	59 055
5	2 549	151.11	61 604
19	2 396	153.22	64 000
3	1 140	157.06	65 140
8	1 603	160.79	66 743
4	1 327	168.97	68 071
22	1 016	171.72	69 087
21	1 591	191.67	70 679
16	1 497	198.30	72 176

Source: own calculations based on coal companies data

The analysis of unit costs shows that costs of production decreased significantly in the considered time period. The average unit cost (in constant prices) decreased from 240 PLN/ton in the first quarter of 1991 to 171 PLN/ton in the fourth quarter of 2004 (decrease by 29%). Such a decrease in costs of production was mainly due to closures of permanently inefficient mines. It is important to note that although reduced production results in increased share of fixed costs, the unit costs in coal sector decreased, nevertheless. The unit costs stabilised at the level of 150 PLN/ton during 2000–2003. However, owing to increased demand on the world coal market and increased production in Polish mines the unit costs reached 171 PLN/ton in 2004. The trends in unit costs in both current and constant prices are shown in Fig. 6 and Fig. 7.

A detailed analysis of cost structure gives a better view on costs reductions in Polish coal mining sector (Fig. 8, Fig. 9). Labour costs (the highest share) accounted to approx. 50% of production costs. The share of “other costs” was approx. 30%, while consumption of materials and energy accounted to 15% and 5%, respectively.

TABLE 5. Unit costs of hard coal production [PLN/ton] – current prices

TABELA 5. Koszty jednostkowe produkcji węgla kamiennego [PLN/ton] – ceny bieżące

Year_Quarter	Average unit cost	Wages	Cons. of materials	Depreciation	Cons. of energy	Other costs
1991_1	30.07	13.04	5.78	2.32	1.62	7.31
1991_2	31.31	13.75	5.73	2.36	1.59	7.89
1991_3	32.27	14.28	5.68	2.31	1.74	8.25
1991_4	31.85	14.94	5.83	2.26	1.82	7.00
1992_1	38.37	17.07	6.90	2.35	2.02	10.02
1992_2	42.34	19.38	6.68	2.60	2.28	11.40
1992_3	52.32	31.15	7.07	2.34	2.35	9.41
1992_4	45.25	19.75	7.39	3.08	2.63	12.40
1993_1	49.30	24.64	7.84	2.72	2.54	11.56
1993_2	58.32	30.51	8.37	3.31	2.93	13.19
1993_3	61.53	32.73	8.18	3.45	3.11	14.06
1993_4	58.82	30.43	8.98	3.06	3.09	13.26
1994_1	70.80	35.23	10.54	3.40	3.65	17.98
1994_2	79.53	41.59	11.95	4.03	3.32	18.65
1994_3	77.79	41.22	11.58	3.67	3.60	17.72
1994_4	78.11	41.10	11.09	3.74	4.23	17.95
1995_1	86.24	42.82	13.41	3.82	4.66	21.53
1995_2	99.16	47.69	15.51	4.89	4.60	26.48
1995_3	96.71	47.77	14.97	3.59	4.42	25.96
1995_4	92.85	45.24	13.74	4.08	5.09	24.70
1996_1	103.20	50.30	15.85	5.17	5.84	26.04
1996_2	113.44	55.66	17.27	6.37	5.10	29.04
1996_3	112.69	55.41	16.62	6.02	4.81	29.83
1996_4	115.98	56.29	15.73	7.39	8.96	27.61
1997_1	115.88	56.99	18.26	6.22	6.47	27.94
1997_2	124.38	60.66	17.44	7.44	6.62	32.22
1997_3	128.39	65.48	17.50	7.29	5.59	32.53
1997_4	133.91	67.61	19.22	6.23	6.96	33.90
1998_1	151.69	76.80	19.82	10.05	8.97	36.05
1998_2	150.96	80.31	17.49	11.04	7.75	34.37
1998_3	144.77	77.29	16.16	9.31	6.67	35.34
1998_4	139.37	74.73	16.37	8.29	7.88	32.11
1999_1	128.70	68.43	15.17	8.49	8.48	28.13
1999_2	129.93	68.66	13.34	9.22	6.21	32.51
1999_3	137.70	73.72	13.80	9.01	6.92	34.25
1999_4	129.39	65.64	14.85	7.96	8.28	32.66
2000_1	122.19	65.01	13.05	7.70	8.56	27.87
2000_2	125.69	66.30	13.47	8.65	7.33	29.93
2000_3	131.31	70.80	13.51	8.18	7.81	31.02
2000_4	133.58	67.39	14.63	7.98	8.43	35.15
2001_1	134.29	66.18	15.33	8.61	9.62	34.55
2001_2	132.80	69.05	15.31	8.86	7.75	31.82
2001_3	136.41	71.31	15.80	8.58	7.69	33.04
2001_4	138.66	69.03	16.35	8.53	9.18	35.57
2002_1	135.19	68.60	16.67	8.79	8.16	32.97
2002_2	136.46	69.11	16.33	9.45	7.36	34.22
2002_3	136.93	71.12	14.75	9.48	6.93	34.64
2002_4	138.01	69.66	14.74	8.57	8.34	36.69
2003_1	138.09	70.15	16.37	9.49	9.13	32.95
2003_2	145.56	76.09	14.61	9.60	6.86	38.40
2003_3	137.75	72.77	14.11	7.95	6.69	36.22
2003_4	142.33	72.87	16.74	15.15	7.68	29.89
2004_1	143.19	71.23	19.38	10.67	8.52	33.39
2004_2	155.49	76.89	22.06	11.98	7.36	37.19
2004_3	158.36	76.05	24.66	11.47	6.94	39.23
2004_4	169.71	73.03	26.91	12.24	7.75	49.78

Source: own calculations based on coal companies data

TABLE 6. Unit costs of hard coal production [PLN/ton] – constant prices (4th quarter of 2004)

TABELA 6. Koszty jednostkowe produkcji węgla kamiennego [PLN/ton] – ceny stałe IV kw. 2004 r.

Year_Quarter	Average unit cost	Wages	Cons. of materials	Depreciation	Cons. of energy	Other costs
1991_1	30.07	13.04	5.78	2.32	1.62	7.31
1991_2	31.31	13.75	5.73	2.36	1.59	7.89
1991_3	32.27	14.28	5.68	2.31	1.74	8.25
1991_4	31.85	14.94	5.83	2.26	1.82	7.00
1992_1	38.37	17.07	6.90	2.35	2.02	10.02
1992_2	42.34	19.38	6.68	2.60	2.28	11.40
1992_3	52.32	31.15	7.07	2.34	2.35	9.41
1992_4	45.25	19.75	7.39	3.08	2.63	12.40
1993_1	49.30	24.64	7.84	2.72	2.54	11.56
1993_2	58.32	30.51	8.37	3.31	2.93	13.19
1993_3	61.53	32.73	8.18	3.45	3.11	14.06
1993_4	58.82	30.43	8.98	3.06	3.09	13.26
1994_1	70.80	35.23	10.54	3.40	3.65	17.98
1994_2	79.53	41.59	11.95	4.03	3.32	18.65
1994_3	77.79	41.22	11.58	3.67	3.60	17.72
1994_4	78.11	41.10	11.09	3.74	4.23	17.95
1995_1	86.24	42.82	13.41	3.82	4.66	21.53
1995_2	99.16	47.69	15.51	4.89	4.60	26.48
1995_3	96.71	47.77	14.97	3.59	4.42	25.96
1995_4	92.85	45.24	13.74	4.08	5.09	24.70
1996_1	103.20	50.30	15.85	5.17	5.84	26.04
1996_2	113.44	55.66	17.27	6.37	5.10	29.04
1996_3	112.69	55.41	16.62	6.02	4.81	29.83
1996_4	115.98	56.29	15.73	7.39	8.96	27.61
1997_1	115.88	56.99	18.26	6.22	6.47	27.94
1997_2	124.38	60.66	17.44	7.44	6.62	32.22
1997_3	128.39	65.48	17.50	7.29	5.59	32.53
1997_4	133.91	67.61	19.22	6.23	6.96	33.90
1998_1	151.69	76.80	19.82	10.05	8.97	36.05
1998_2	150.96	80.31	17.49	11.04	7.75	34.37
1998_3	144.77	77.29	16.16	9.31	6.67	35.34
1998_4	139.37	74.73	16.37	8.29	7.88	32.11
1999_1	128.70	68.43	15.17	8.49	8.48	28.13
1999_2	129.93	68.66	13.34	9.22	6.21	32.51
1999_3	137.70	73.72	13.80	9.01	6.92	34.25
1999_4	129.39	65.64	14.85	7.96	8.28	32.66
2000_1	122.19	65.01	13.05	7.70	8.56	27.87
2000_2	125.69	66.30	13.47	8.65	7.33	29.93
2000_3	131.31	70.80	13.51	8.18	7.81	31.02
2000_4	133.58	67.39	14.63	7.98	8.43	35.15
2001_1	134.29	66.18	15.33	8.61	9.62	34.55
2001_2	132.80	69.05	15.31	8.86	7.75	31.82
2001_3	136.41	71.31	15.80	8.58	7.69	33.04
2001_4	138.66	69.03	16.35	8.53	9.18	35.57
2002_1	135.19	68.60	16.67	8.79	8.16	32.97
2002_2	136.46	69.11	16.33	9.45	7.36	34.22
2002_3	136.93	71.12	14.75	9.48	6.93	34.64
2002_4	138.01	69.66	14.74	8.57	8.34	36.69
2003_1	138.09	70.15	16.37	9.49	9.13	32.95
2003_2	145.56	76.09	14.61	9.60	6.86	38.40
2003_3	137.75	72.77	14.11	7.95	6.69	36.22
2003_4	142.33	72.87	16.74	15.15	7.68	29.89
2004_1	143.19	71.23	19.38	10.67	8.52	33.39
2004_2	155.49	76.89	22.06	11.98	7.36	37.19
2004_3	158.36	76.05	24.66	11.47	6.94	39.23
2004_4	169.71	73.03	26.91	12.24	7.75	49.78

Source: own calculations based on coal companies data

TABLE 7. The structure of hard coal production costs [%]

TABELA 7. Struktura kosztów produkcji węgla kamiennego [%]

Year_Quarter	Average unit cost	Wages	Cons. of materials	Depreciation	Cons. of energy	Other costs
1991_1	30.07	13.04	5.78	2.32	1.62	7.31
1991_2	31.31	13.75	5.73	2.36	1.59	7.89
1991_3	32.27	14.28	5.68	2.31	1.74	8.25
1991_4	31.85	14.94	5.83	2.26	1.82	7.00
1992_1	38.37	17.07	6.90	2.35	2.02	10.02
1992_2	42.34	19.38	6.68	2.60	2.28	11.40
1992_3	52.32	31.15	7.07	2.34	2.35	9.41
1992_4	45.25	19.75	7.39	3.08	2.63	12.40
1993_1	49.30	24.64	7.84	2.72	2.54	11.56
1993_2	58.32	30.51	8.37	3.31	2.93	13.19
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1994_1	70.80	35.23	10.54	3.40	3.65	17.98
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1995_2	99.16	47.69	15.51	4.89	4.60	26.48
1995_3	96.71	47.77	14.97	3.59	4.42	25.96
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1998_1	151.69	76.80	19.82	10.05	8.97	36.05
1998_2	150.96	80.31	17.49	11.04	7.75	34.37
1998_3	144.77	77.29	16.16	9.31	6.67	35.34
1998_4	139.37	74.73	16.37	8.29	7.88	32.11
1999_1	128.70	68.43	15.17	8.49	8.48	28.13
1999_2	129.93	68.66	13.34	9.22	6.21	32.51
1999_3	137.70	73.72	13.80	9.01	6.92	34.25
1999_4	129.39	65.64	14.85	7.96	8.28	32.66
2000_1	122.19	65.01	13.05	7.70	8.56	27.87
2000_2	125.69	66.30	13.47	8.65	7.33	29.93
2000_3	131.31	70.80	13.51	8.18	7.81	31.02
2000_4	133.58	67.39	14.63	7.98	8.43	35.15
2001_1	134.29	66.18	15.33	8.61	9.62	34.55
2001_2	132.80	69.05	15.31	8.86	7.75	31.82
2001_3	136.41	71.31	15.80	8.58	7.69	33.04
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2002_3	136.93	71.12	14.75	9.48	6.93	34.64
2002_4	138.01	69.66	14.74	8.57	8.34	36.69
2003_1	138.09	70.15	16.37	9.49	9.13	32.95
2003_2	145.56	76.09	14.61	9.60	6.86	38.40
2003_3	137.75	72.77	14.11	7.95	6.69	36.22
2003_4	142.33	72.87	16.74	15.15	7.68	29.89
2004_1	143.19	71.23	19.38	10.67	8.52	33.39
2004_2	155.49	76.89	22.06	11.98	7.36	37.19
2004_3	158.36	76.05	24.66	11.47	6.94	39.23
2004_4	169.71	73.03	26.91	12.24	7.75	49.78

Source: own calculations based on coal companies data

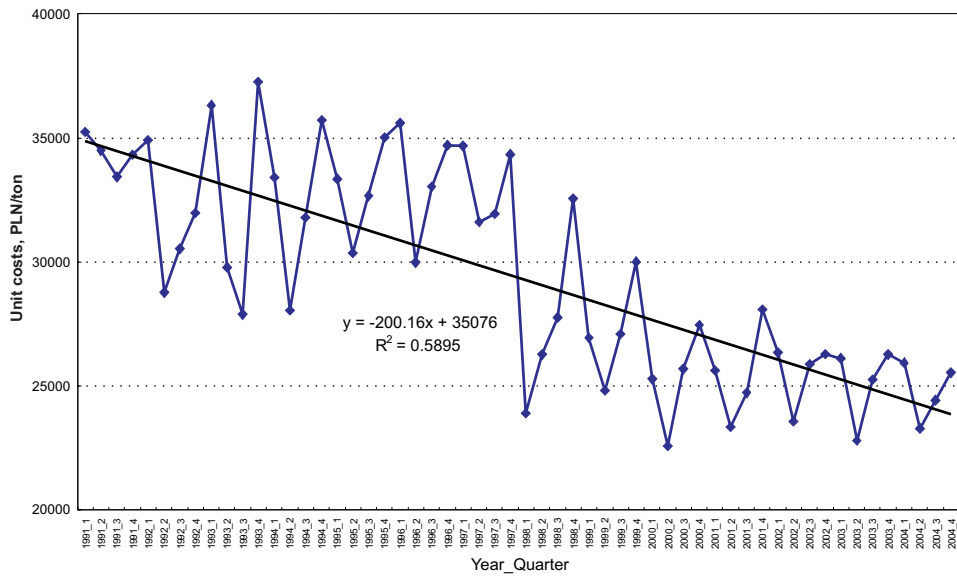


Fig. 4. Production of hard coal in Poland, 1991–2004 [000 ton]

Source: own calculations based on coal companies data

Rys. 4. Produkcja węgla kamiennego w Polsce, 1991–2004 [tys. ton]

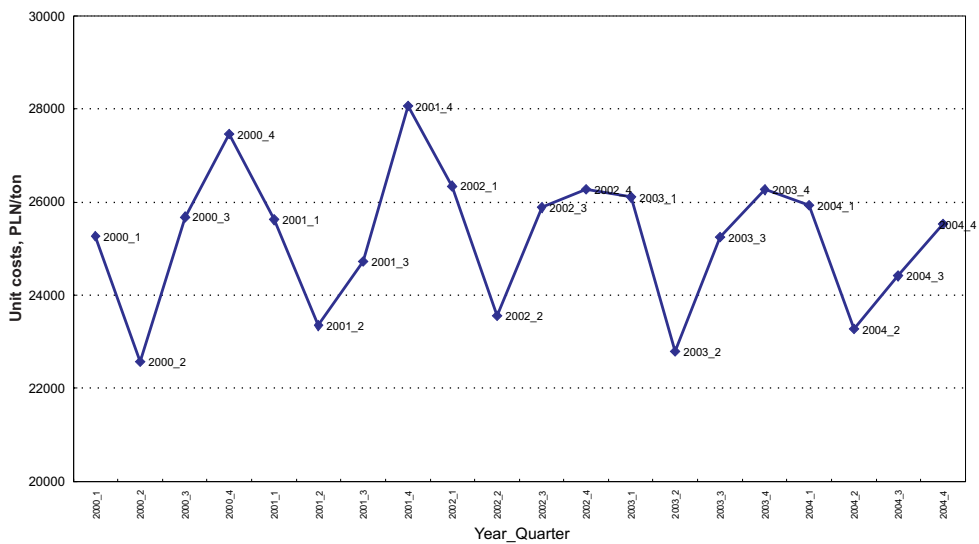


Fig. 5. Production of hard coal in Poland, 2000–2004 [000 ton]

Source: own calculations based on coal companies data

Rys. 5. Produkcja węgla kamiennego w Polsce, 2000–2004 [tys. ton]

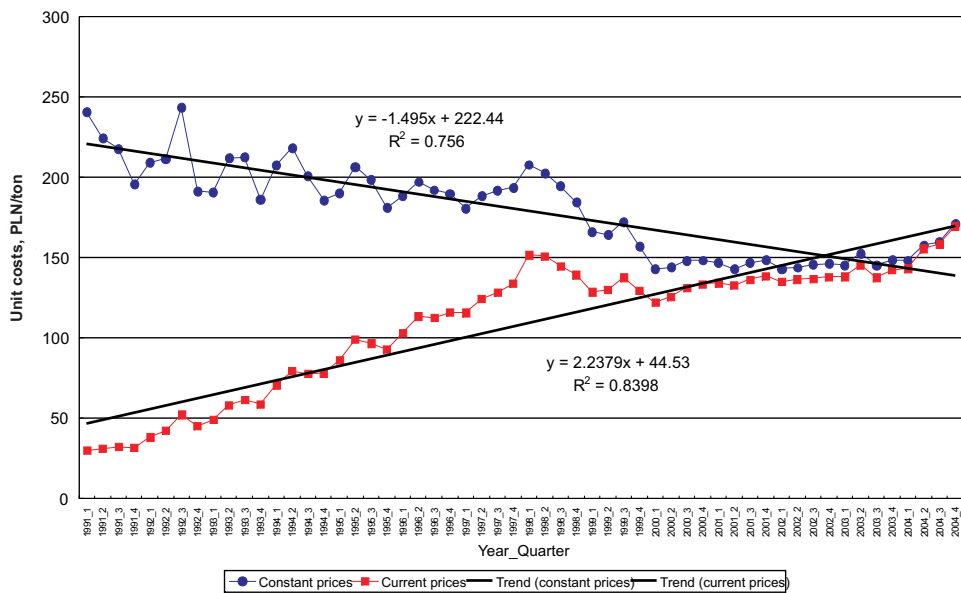


Fig. 6. Unit costs of hard coal production, 1991–2004 [PLN/ton]
Source: own calculations based on coal companies data

Rys. 6. Koszty jednostkowe produkcji węgla kamiennego, 1991–2004 [PLN/ton]

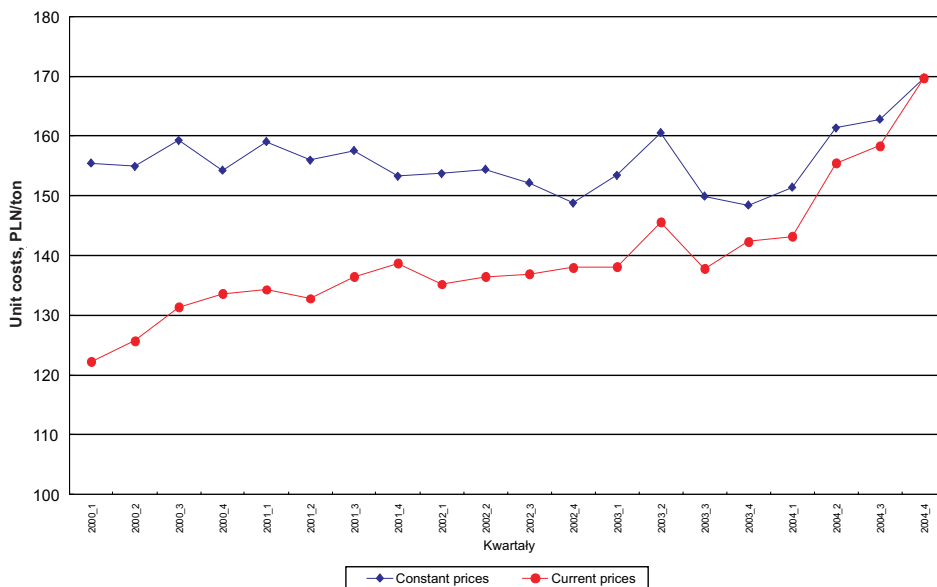


Fig. 7. Unit costs of hard coal production, 2000–2004 [PLN/ton]
Source: own calculations based on coal companies data

Rys. 7. Koszty jednostkowe produkcji węgla kamiennego, 2000–2004 [PLN/ton]

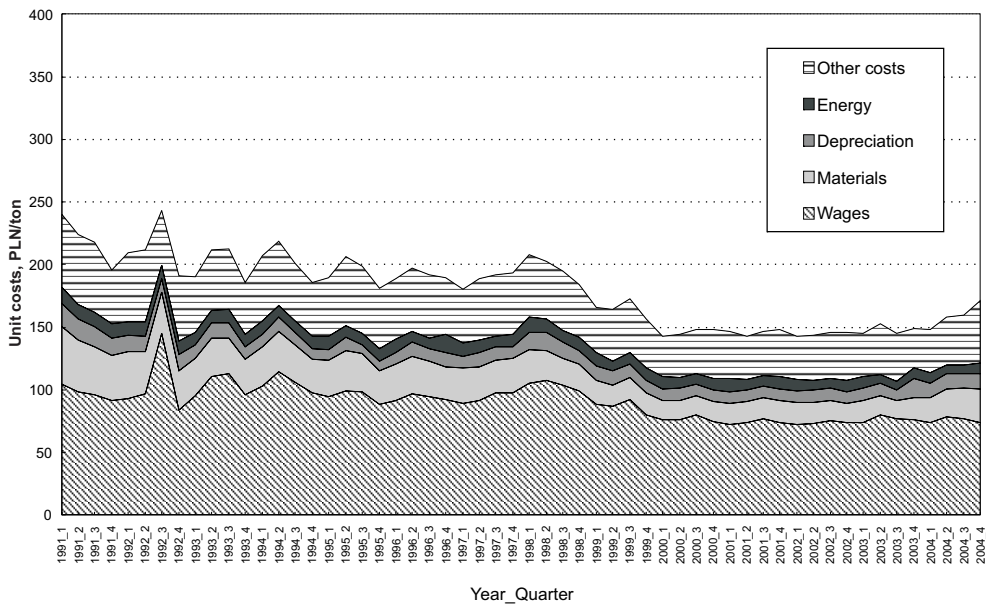


Fig. 8. Share of the cost components in unit cost, 1991–2004 [PLN/ton]
 Source: own calculations based on coal companies data

Rys. 8. Struktura kosztów jednostkowych, 1991–2004 [PLN/ton]

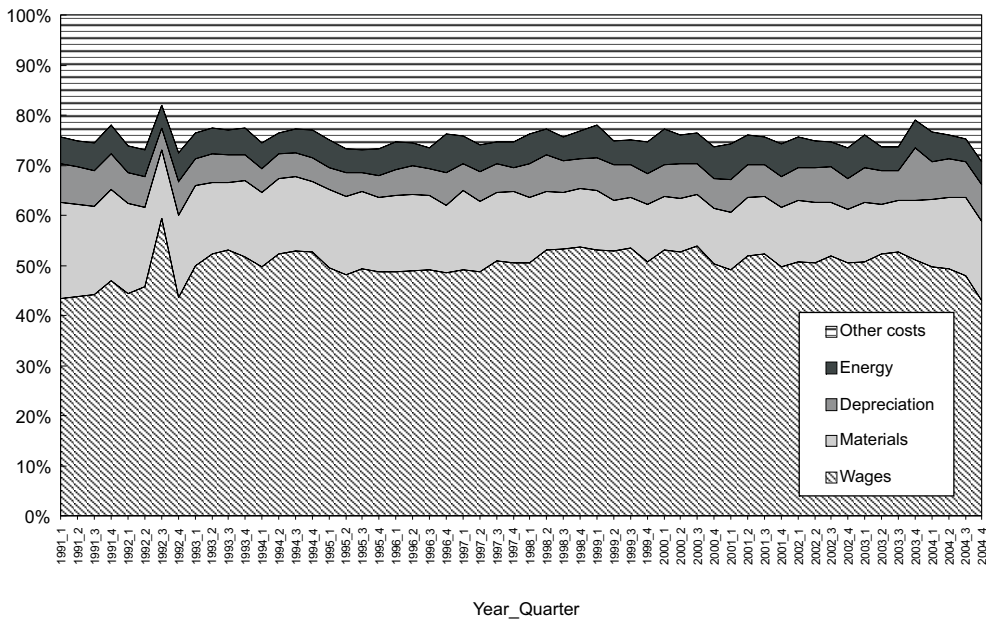


Fig. 9. The structure of unit cost, 1991–2004 [%]
 Source: own calculations based on coal companies data

Rys. 9. Struktura kosztów jednostkowych, 1991–2004 [%]

In order to assess the differences in reduction of the particular cost components it is necessary to compare the dynamics of the unit cost of each component with the dynamics of the average unit cost of hard coal production (Fig. 10 – Fig. 14). The analysis shows that the

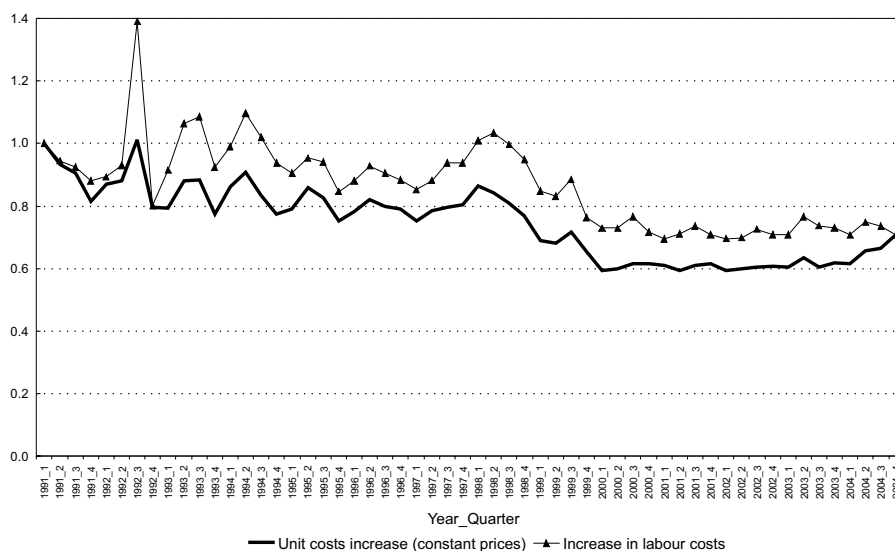


Fig. 10. Labour costs indices – constant prices [%]
Source: own calculations based on coal companies data

Rys. 10. Wskaźnik dynamiki kosztów wynagrodzeń z narzutami – ceny stałe [%]

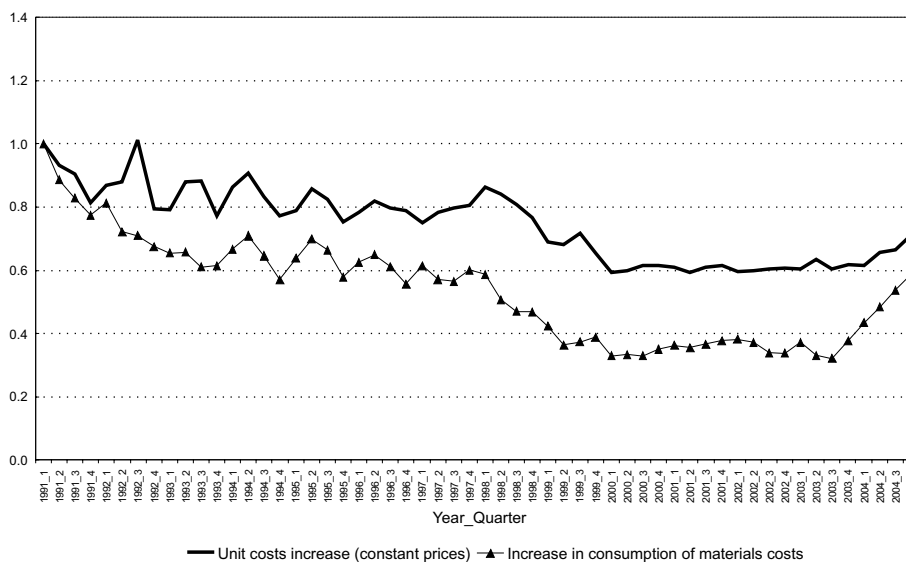


Fig. 11. Consumption of materials costs indices – constant prices [%]
Source: own calculations based on coal companies data

Rys. 11. Wskaźnik dynamiki kosztów materiałów – ceny stałe [%]

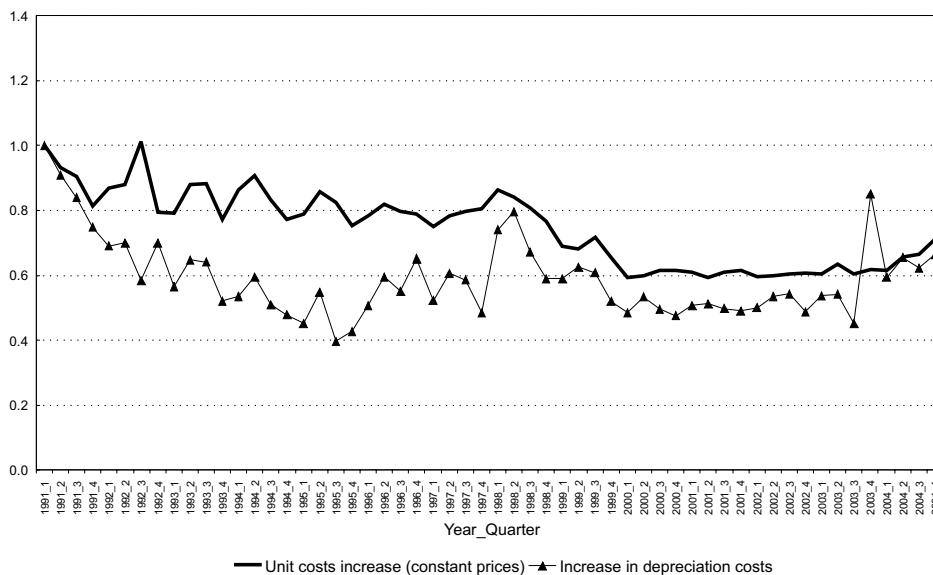


Fig. 12. Depreciation costs indices – constant prices [%]
Source: own calculations based on coal companies data

Rys. 12. Wskaźnik dynamiki kosztów amortyzacji – ceny stałe [%]

decrease in labour costs was less intense than the decrease in unit costs (all components included) – in constant prices. On the other hand, consumption of materials and depreciation

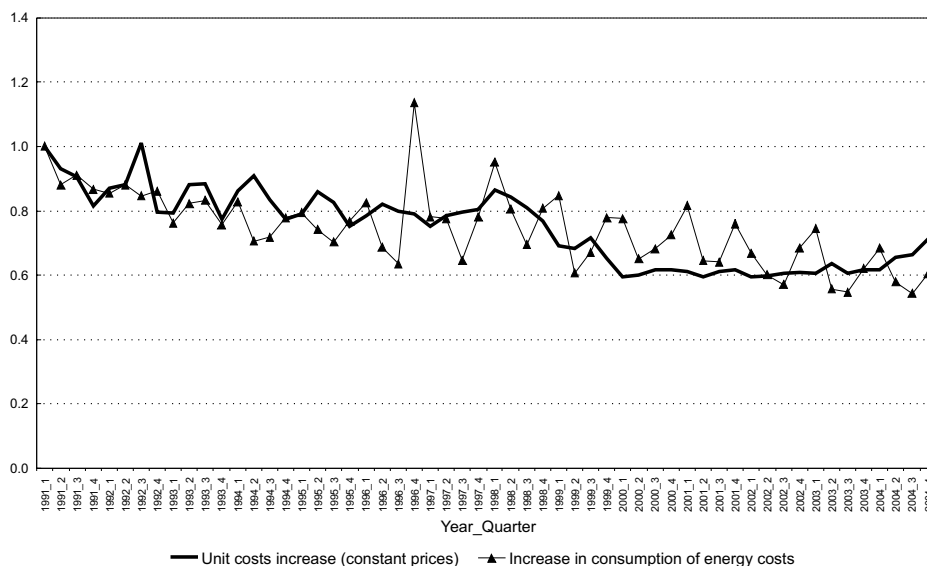


Fig. 13. Energy costs indices – constant prices [%]
Source: own calculations based on coal companies data

Rys. 13. Wskaźnik dynamiki kosztów energii – ceny stałe [%]

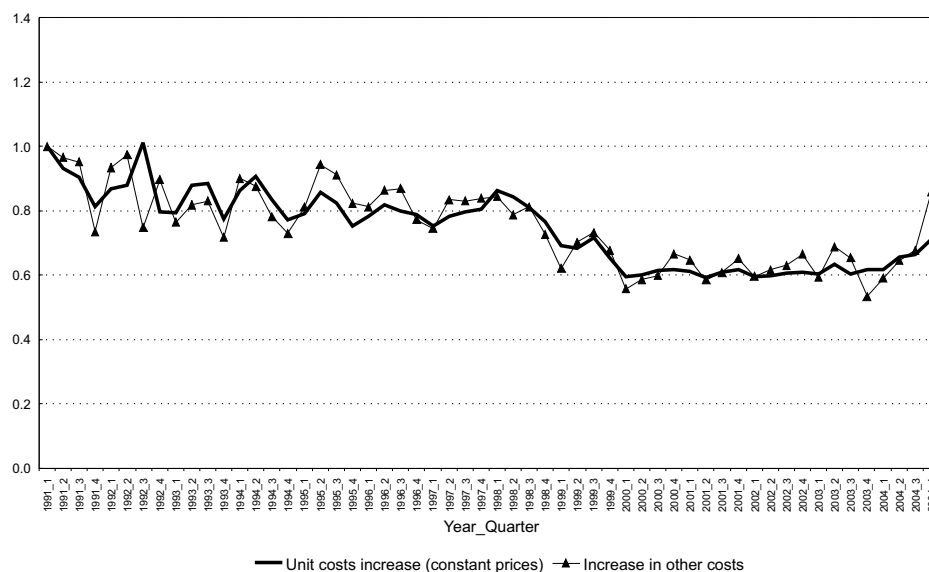


Fig. 14. Other costs indices – constant prices [%]
 Source: own calculations based on coal companies data

Rys. 14. Wskaźnik dynamiki pozostałych kosztów – ceny stałe [%]

are reduced more intensively than the unit costs. The only exception is the last quarter in 2004, when costs related to the consumption of materials increased significantly. Similarly, other costs in which services are included, increased in 2004, which was the result of increased coal production. Indeed with reduction of own employment more services must be outsourced. The variation of both, the other costs and costs related to the consumption of energy, are similar to the variation of the average unit costs.

Conclusions

This survey revealed significant differences in costs of Polish coal mines production. The cost of hard coal production varied from 105.88 PLN/ton to 199.06 PLN/ton, with the average of 142.78 PLN/ton. The main component in the cost structure are wages with the average share of 53.47%. What is worth noting, the share of wages is less significant in the coking coal mines (48.02%) than in steam coal mines (55.06%).

Transformation of Polish economy (shift from heavy industry to lighter industries and services) and decrease of energy intensity of the GDP affected the coal sector which was forced to reduce its production. The annual coal production decreased from 137.5 mln tons in 1991 to approximately 100 mln tons in 2004. The downward trend has been constant since 1991. However, it is noticeable that the production of coal has stabilised at the level of 25 mln tons quarterly since 2000.

As a result of restructuring processes the unit costs of coal production decreased significantly in the considered time period (1991–2004). The average unit cost (in constant prices) decreased from 240 PLN/ton in the first quarter of 1991 to 171 PLN/ton in the fourth quarter of 2004 (by 29%), what was mainly due to the closure of permanently inefficient mines and increased efficiency in operating ones.

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Koszty produkcji węgla kamiennego w Polsce

Streszczenie

Artykuł jest wynikiem prac prowadzonych w ramach projektu “Evaluation of State aid for the coal industry” prowadzonego przez Europe Economics, Fraunhofer ISI, BSR Sustainability wraz z Krakow Institute for Sustainable Energy oraz Instytutem Gospodarki Surowcami Mineralnymi i Energią PAN. Raport zawierał studium przypadków przeprowadzonych w czterech państwach europejskich, tj. w Czechach, Niemczech, Hiszpanii i w Polsce.

Artykuł ten powstał na podstawie badań przeprowadzonych w Polsce. Celem artykułu była analiza trendów kosztów produkcji węgla kamiennego, zarówno dla całego sektora węglowego, jak i dla poszczególnych kopalń. Przedstawiono dwa podejścia do analizy kosztów produkcji węgla kamiennego. W pierwszym skupiono się na analizie składników kosztów produkcji, w drugim natomiast podjęto problematykę analizy jednostkowych kosztów produkcji dla całego sektora węgla kamiennego w Polsce.

SŁOWA KLUCZOWE: węgiel kamienny, koszty produkcji